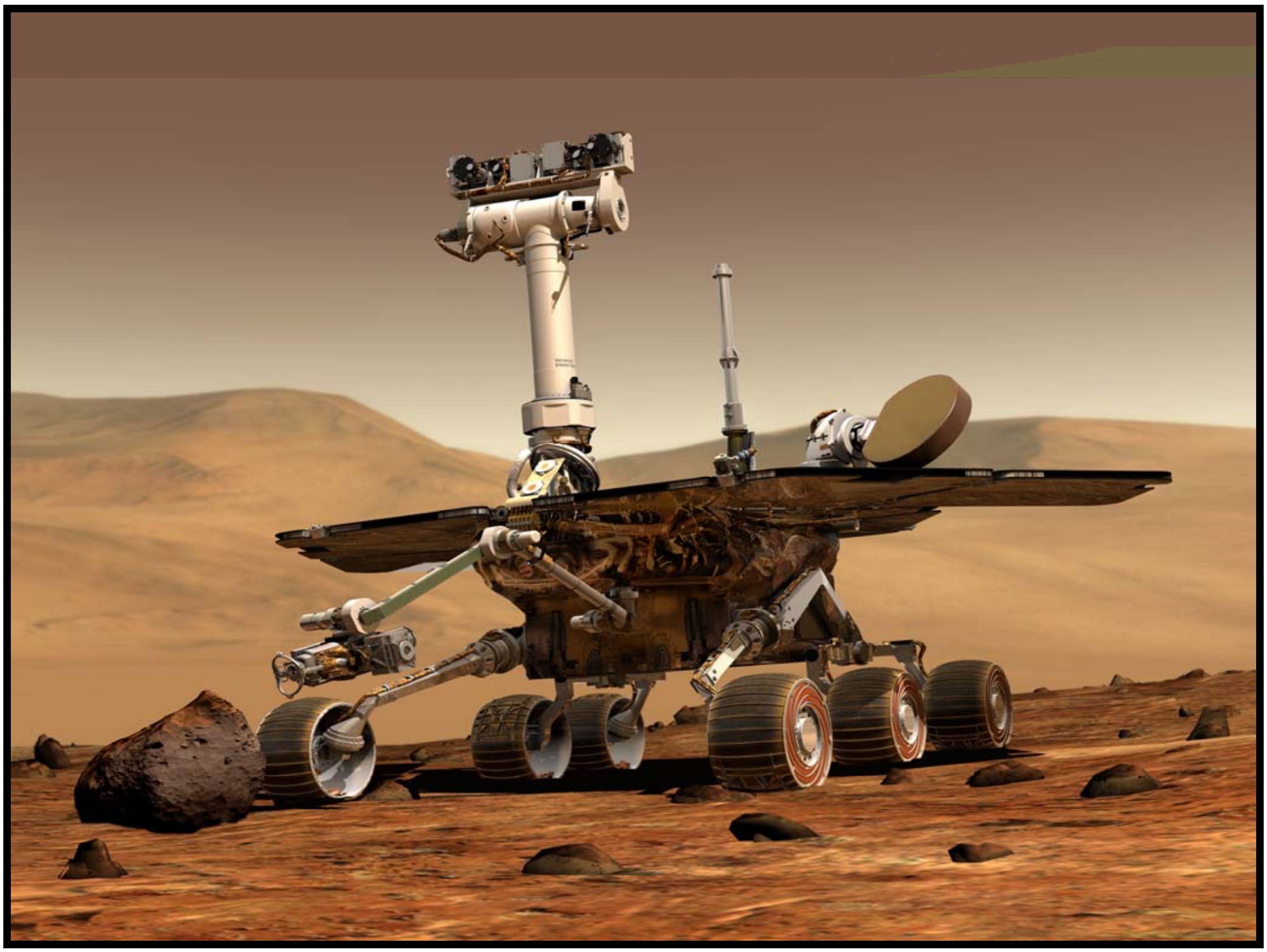
National Aeronautics and Space Administration

Mission to Mars Expedition

An Educator Guide with Activities in Space Exploration Design



Mission to Mars Challenge
A Digital Learning Network Experience

Designed To Share

The Vision for Space Exploration

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Digital Learning Network (DLN) Expedition

A DLN Expedition is a one time connection that allows students to experience NASA first-hand. Each expedition features an integrated educational package of grade-appropriate instruction and activities centered around a 50 minute videoconference. Students participate in a Question and Answer session with a NASA JSC education specialist or a NASA Subject Matter Expert.

The sequence for a DLN Expedition includes:

- Students complete vocabulary and Pre-Classroom Activity
- A one time DLN videoconference connection with in-formal student participation.
- Complete Post-Activity Assessment and complete online evaluation for teacher and students.

Expedition Overview

Grade Level **5^{th}-8th**

Focus Question
How would you protect a rover in order to make a safe landing on Mars?

Instructional Objectives
Students will understand the importance of weight-mass in successful landing
Students will research current rover landings on Mars.
Students will be involved in the team building process.

National Standards
National Science Education Standards (NSES)
Science as Inquiry – Content Standard A
Science and Technology – Content Standard E
National Council of Teachers of Mathematics (NCTM)
Standard 4 – Measurement   Standard 8 – Communication
International Technology Education Association (ITEA)
Design – Standard 10
The Designed World – Standard 17

Texas State Standards

SEQUENCE OF EVENTS

Pre-Conference Requirements

Online Pre-assessment A pre-assessment tool is available to determine the students' level of understanding prior to the videoconference. Suggested answers are included.

Expedition Videoconference

Expedition Videoconference (About 45-60 minute conference)
Travel to the Red Planet and discover what it takes to land robotic missions on the uninviting terrain of the Martian soil. Be aware of intense dust storms, huge craters, enormous canyons and staggering volcanoes. Imagine trying to slow down delicate instrumentation from 12,000mph to 0 in a window of six minutes and at the same time finding a safe place to land. Think it can't be done? NASA has achieved these remarkable tasks with Spirit and Opportunity. Learn this and much more as we take you on a journey to the Red Planet!

Expedition Videoconference Guidelines

Expedition Videoconference Outline

Post-Conference Requirements

Online Post-assessment
A post-assessment tool is available to determine changes in student levels of understanding.

NASA Education Evaluation Information System (NEEIS) Feedback Forms

Educator and student feedback forms are available online for all DLN events.

National Standards

National Science Education Standards (NSES)

Science as Inquiry – Content Standard A
As a result of activities in grades 5-8 and 9-12, all students should develop:
- Abilities necessary to do scientific inquiry.
- Understandings about scientific inquiry.

Science and Technology – Content Standard E
As a result of activities in grades 5-8 and 9-12, all students should develop:
- Abilities of technological design.
- Understandings about science and technology.

National Council of Teachers of Mathematics (NCTM)

Standard 4 – Measurement
In all grades students should:
- Apply a variety of techniques, tools, and formulas for determining measurement.

Standard 8 – Communication
In all grades students should:
- Organize and consolidate their mathematical thinking to communicate with others.
- Express mathematical ideas coherently and clearly to peers, teachers, and others.

International Technology Education Association (ITEA)

Design – Standard 10
- Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving

The Designed World – Standard 17
- Students will develop an understanding of and be able to select and use information and communication technologies.

Texas Essential Knowledge and Skills

Texas Essential Knowledge and Skills

8.1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(B) Make wise choices in the use and conservation of resources and the disposal or recycling of materials.

8.2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:

(A) Plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(B) Collect data and make measurements with precision;

(C) Organize, analyze, evaluate, make inferences, and predict trends from data; and

(D) Communicate valid conclusions.

8.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) Analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;

Pre-Conference Requirements

Online Pre-Assessment

A week before the event, students will need to take the online pre-conference assessment. This short assessment will provide useful background information for the presenters to prepare for the videoconference.

Pre-Conference Assessment Questions

1. **How big do dust storms get on Mars?**
2. **What is the name of the largest canyon on Mars?**
3. **How come volcanoes can grow so large on Mars?**
4. **What are the names of the two current rovers exploring Mars?**
5. **What are the average temperatures on the red planet?**
6. **What are some of the similarities between Earth and Mars?**
7. **How long would a trip to Mars take with current technology?**
8. **What are some on the dangers of long-term space travel?**
9. **What are the current rovers on Mars searching for?**
10. **What would be the best landing site on Mars and why?**

Pre-Conference Requirements

Teacher's Page with suggested answers:
Answers to Pre and Post Assessment Questions

How big do dust storms get on Mars?
Dust storms on Mars are much larger than they are on Earth and can completely cover the entire planet.

What is the name of the largest canyon on Mars?
Valles Marinars is 2500 miles (4000 km) long, 310 miles (500 km) wide by 4.3 miles (7 km) deep. If this canyon system existed on Earth, it would stretch from San Francisco to Boston: essentially the entire length of the United States.

How come volcanoes can grow so large on Mars?
Two reasons: a) lack of surface gravity and b) lack of plate movement

What are the names of the two current rovers exploring Mars?
Spirit and Opportunity- NASA conducted an essay contest to name the rovers. The winner was Sofi Collis, a 9 year old from Scottsdale, AZ.

What are the average temperatures on the red planet?
The average surface temperature on Mars is a frigid minus 81 degrees Fahrenheit (-62.77 degrees Celsius) with extremes that range from 75 degrees Fahrenheit (23.88 Celsius) to less than minus 100 degrees Fahrenheit (-73.33 Celsius). In comparison, Earth's average surface temperature is about 58 degrees Fahrenheit (14.4 degrees Celsius).

What are some of the similarities between Earth and Mars?
A rotation rate of 24 hours 37 min (Earth: 23 hours 56 min.). Mars has an axial tilt of 24 degrees (Earth 23.5 degrees). It has a gravitational pull one-third of Earth's. It is close enough to the sun to experience seasons. Mars is about 50 percent farther from the sun than Earth.

How long would a trip to Mars take with current technology?
Roughly 6 to 8 months.

What are some on the dangers of long-term space travel?
Some dangers include exposure to solar radiation, loss of bone density during long-term space travel and life-support such as food for long periods of time.

What are the current rovers on Mars searching for?
The current rovers are searching for evidence of past signs of water on Mars. They are also trying to search for the mineral hematite which is formed in the presence of water.

What would be the best landing site on Mars?
A good example of a landing site is one that is relatively flat and in the case of the current rovers a crater site where exposure of layers can be easily identified.

Expedition Videoconference Guidelines

Audience Guidelines

Teachers, please review the following points with your students prior to the event:

- Videoconference is a two-way event. Students and NASA presenters can see and hear one another.
- Students are sometimes initially shy about responding to questions during a distance learning session. Explain to the students that this is an interactive medium and we encourage questions.
- Students should speak in a loud, clear voice. If a microphone is placed in a central location instruct the students to walk up and speak into the microphone.
- Teacher(s) should moderate students' questions and answers.

Teacher Event Checklist

Date Completed	Pre-Conference Requirements
	1. Print a copy of the module.
	2. Have the students complete the online pre-assessment.
	3. Email questions for the presenter. This will help focus the presentation on the groups' specific needs.
	4. Review the Audience Guidelines, which can be found in the previous section.
	Day of the Conference Requirements
	1. The students are encouraged to ask the NASA presenter qualifying questions about the Expedition.
	2. Follow up questions can be continued after the conference through e-mail.
	Post - Conference Requirements
	1. Have the students take the online Post-Assessment to demonstrate their knowledge of the subject.
	2. Use the provided rubric as guidelines for content and presentation criteria.
	3. Teacher(s) and students fill out the event feedback.

Expedition Videoconference Outline

Introduction to Challenge Videoconference

Travel to the Red Planet and discover what it takes to land robotic missions on the uninviting terrain of the Martian soil. Be aware of intense dust storms, huge craters, enormous canyons and staggering volcanoes. Imagine trying to slow down delicate instrumentation from 12,000mph to 0 in a window of six minutes and at the same time finding a safe place to land. Think it can't be done? NASA has achieved these remarkable tasks with Spirit and Opportunity. Learn this and much more as we take you on a journey to the Red Planet!

<u>Outline for Video Conference One</u>

I. **Welcome**
II. **Introduction**
III. **Moon and NASA Vision**
IV. **Science Fiction**
V. **NASA Images**
VI. **Earth and Mars Comparison**
VII. **Time-developing similarities**
VIII. **Surface Geologic Features**
IX. **Weather**
X. **Rovers and EDL**
XI. **Careers/Website**
XII. **Q&A**
XIII. **Good-Bye**

Pre-Classroom Activities

Mars Rover Egg Drop and Landing (EDL)

National Science Education Standards:

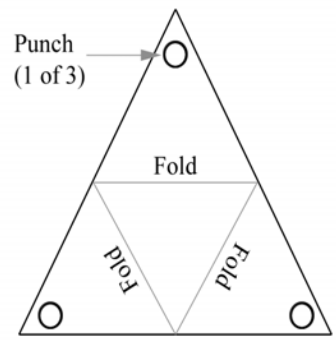
Standards A: Abilities of inquiry science

Standards E: Abilities of technological design.

National Technology Education Standards:

NT.K-12.3 Technology Productivity Tools

NT.K-12.6 Technology Problem-Solving and Decision-Making Tools

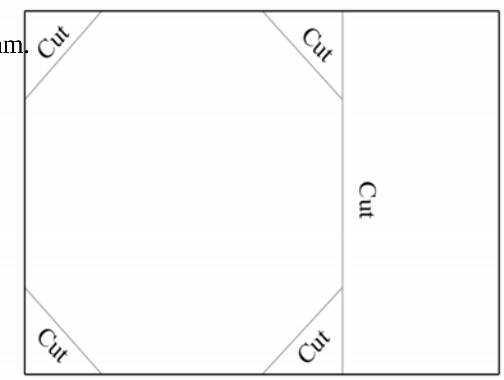


Materials:

1 cereal box, 4 balloons, 5 m of string, newspaper,
1 egg, tape, scissors, ruler, pencil, hole punch

Lander

1. Starting with a cereal box, unfold the box
2. On one side of the box, trace an equilateral triangle, 22 cm (8.5in) on a side
3. Cut out the triangle and punch a single hole near each vertex.
4. Fold the triangle into a tetrahedron to form a “Lander”.
5. Place the egg inside the tetrahedron and tape closed along each seam.
6. Tie a 1-m (40 in) piece of string through the holes at the vertices.



Parachute

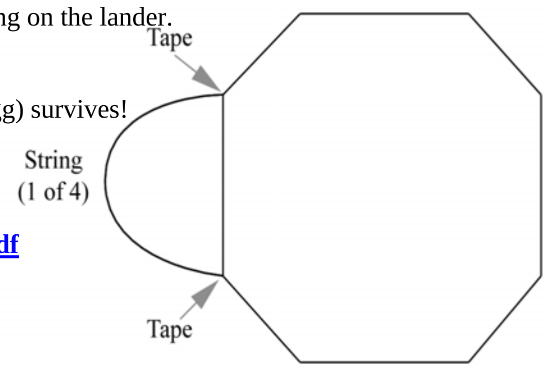
1. Unfold a large piece of newspaper.
2. Cut off the edge of the newspaper sheet to form a square.
3. Cut off each corner of the square to form an octagon.
4. Using four 1-m (40 in) pieces of string, tape each end of each of string to adjacent corners of the octagon parachute.

Air Bags

1. Inflate four 25-cm (10 in) balloons.
2. Using tape rolled back on itself, tape each balloon to each face of the lander.
3. Gather the four strings on the parachute and tie them to the string on the lander.

Entry, Descent and Landing (EDL)

Drop your “pathfinder” from a high place and see if your payload (egg) survives!



For further information visit:
http://marsweb.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf

Post-Conference

Online Post-Assessment

After the event students will need to take the online post-conference assessment. (These questions are the same questions used in the pre-assessment.) The short assessment will help us measure student learning and identify any changes that need to be made in future programs.

Post-Conference Assessment Questions

1. **How big do dust storms get on Mars?**
2. **What is the name of the largest canyon on Mars?**
3. **How come volcanoes can grow so large on Mars?**
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6. **What are some of the similarities between Earth and Mars?**
7. **How long would a trip to Mars take with current technology?**
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9. **What are the current rovers on Mars searching for?**
10. **What would be the best landing site on Mars and why?**

NASA Education Evaluation Information System (NEEIS)

Please complete an online evaluation form to provide feedback on the NASA Expedition.

Feedback from you and a few of your students would be appreciated.

http://nasadln.nmsu.edu/dln/content/feedback/

Digital Learning Network

Certificate of Completion

This certifies that

Has completed NASA's
Mission to Mars Challenge

Instructor

Vocabulary

Adaptation: adjustments in an organism or its parts to help it live in its environment.

Aerobraking: The use of atmospheric drag to slow a spacecraft.

Atmosphere: The gaseous mass or envelope surrounding a celestial body, especially the one surrounding the earth, and retained by the celestial body's gravitational field.

Axis of rotation: The straight line, or imaginary, passing through a rotating body and is the line about which that body rotates.

Composition: the general makeup or characteristics of material such as rock or soil.

Deploy: To bring (forces or material) into action. To distribute (persons or forces) systematically or strategically.

Descent: The act or an instance of descending. A way down. A downward incline, or passage; a slope.

Eruption: the outflow of hot lava and other materials like ash from a volcano or crack in rock.

Escape velocity: the speed that any object must acquire in order to escape from a planet's gravitation.

Gravity: The natural force of attraction exerted by a celestial body, such as Earth, upon objects at or near its surface, tending to draw them toward the center of the body.

Habitat: the natural place where an organism lives, including the surrounding environment.

Kilometer: A metric unit of length equal to 1,000 meters (0.62 mile).

Payload: The total weight of passengers and cargo that an aircraft carries or can carry. The total weight of the instruments, crew, and life-support systems that a spacecraft carries or can carry. The passengers, crew, instruments, or equipment carried by an aircraft, spacecraft, or rocket.

Retro-rocket: A rocket engine used to retard, arrest, or reverse the motion of a vehicle, such as an aircraft, missile, or spacecraft. A small rocket engine on a larger rocket or spacecraft that is fired to slow or alter its course.

Simulation: Imitation or representation, as of a potential situation or in experimental testing. Representation of the operation or features of one process or system through the use of another: computer simulation of an in-flight emergency.

Stratigraphy: layers of rock, often as viewed sideways like a stack of pancakes.

Trajectory: the curving path of a spacecraft.

Name ____________________ **Date ________________**

Word Scramble
Mars Challenge Vocabulary

P	R	T	D	T	T	G	E	P	I	P	T	T	S	N	K	A	B	E	E	O	C	P	I	L
A	N	N	I	G	N	O	S	T	T	G	R	M	Y	A	D	O	T	B	A	S	N	R	R	A
R	M	S	A	R	I	G	O	T	V	R	S	O	I	U	R	T	L	I	A	P	N	E	P	O
E	C	N	I	M	I	P	R	E	R	I	A	M	T	L	E	D	E	L	E	E	N	A	N	O
O	T	K	I	M	R	T	T	A	S	A	N	J	O	T	A	L	E	I	I	T	Y	A	E	Y
T	L	O	D	I	U	P	T	Y	V	C	T	T	E	E	D	H	A	E	C	L	D	E	R	R
N	C	O	E	O	S	L	A	N	N	I	A	I	A	C	T	T	R	R	O	L	A	P	L	D
A	T	F	A	Y	A	T	A	A	V	Y	T	P	G	N	T	N	A	A	A	I	K	E	P	A
B	P	S	O	O	A	I	T	T	E	T	T	Y	E	R	O	O	D	T	O	A	T	D	N	A
D	R	A	R	N	N	Y	T	R	I	D	O	H	V	V	A	I	R	E	I	R	I	D	A	N
A	A	T	I	I	O	T	N	M	E	O	T	S	A	E	E	P	T	Y	D	B	U	S	T	X
B	L	Y	A	V	L	O	I	O	A	C	N	C	J	T	T	L	H	I	S	A	A	Y	D	R
T	E	I	O	A	X	L	G	O	I	O	R	T	A	K	P	N	O	Y	S	V	T	H	H	P
L	I	R	T	L	E	N	D	C	O	T	E	T	E	G	A	R	Y	C	N	O	A	O	T	S
P	R	O	E	E	P	S	R	B	T	K	A	T	M	I	N	E	E	A	I	E	P	E	P	A
S	P	A	A	N	C	E	R	E	C	B	I	T	I	K	N	I	I	P	R	T	R	M	A	Y
S	R	M	O	E	A	S	D	O	N	A	O	C	O	O	A	H	K	E	S	E	Y	R	O	E
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P	A	D	R	A	T	O	M	G	H	A	D	T	O	E	F	E	A	P	R	N	A	O	O	N
H	A	M	E	T	R	O	D	B	Y	E	A	O	R	R	M	O	S	T	E	B	I	T	T	O
T	L	I	R	T	A	P	A	O	S	T	T	O	T	O	C	O	S	A	L	T	O	E	E	I
O	N	I	E	T	T	I	M	C	P	E	I	R	L	T	M	R	E	I	P	O	I	R	E	R
O	R	R	O	A	T	I	E	A	O	O	O	I	E	T	O	R	T	U	X	R	T	G	E	A
C	A	A	T	I	L	N	D	K	N	J	K	O	A	U	M	C	R	E	I	A	O	I	M	A
X	C	E	E	E	T	A	A	A	E	P	N	R	S	A	P	E	O	T	C	N	H	I	E	R

Adaptation	**Aerobraking**	**Atmosphere**	**Axis of Rotation**
Composition	**Deploy**	**Descent**	**Eruption**
Escape Velocity	**Gravity**	**Habitat**	**Kilometer**
Payload	**Retrorocket**	**Simulation**	**Stratigraphy**
Trajectory			

Name ___________________________ Digital Learning Network

Date _________________________ Science

Unscramble the words below:

1. jeTorcatry________________

2. cke-rrRoteot________________

3. eeorilmtK________________

4. yiravtG________________

5. noipoCstiom________________

6. dottpainAa________________

7. tsDnece________________

8. rinkgeabAor________________

9. RfoinsAiatotox________________

10. pthatrgSaiyr________________

11. tiHtbaa________________

12. atEcspoeVyelic________________

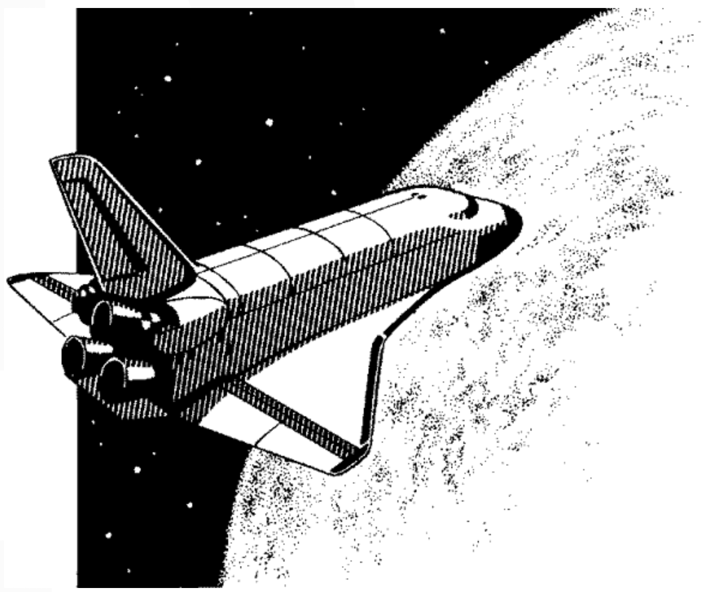
13. ayPaodl________________

14. onriputE________________

15. tuiaiolmnS________________

16. pelDoy________________

17. tpAhmreose________________



Word Scramble

Mars Challenge Vocabulary

Answers

1. **jeTorcatry is Trajectory.**
2. **cke-rrRoteot is Retro-rocket .**
3. **eeorilmtK is Kilometer.**
4. **yiravtG is Gravity .**
5. **noipoCstiom is Composition.**
6. **dottpainAa is Adaptation.**
7. **tsDnece is Descent.**
8. **rinkgeabAor is Aerobraking.**
9. **RfoinsAiatotox is Axis of Rotation .**
10. **pthatrgSaiyr is Stratigraphy.**
11. **tiHtbaa is Habitat.**
12. **atEcspoeVyelic is Escape Velocity .**
13. **ayPaodl is Payload.**
14. **onriputE is Eruption.**
15. **tuiaiolmnS is Simulation.**
16. **pelDoy is Deploy.**
17. **tpAhmreose is Atmosphere.**

Resources

Information of Past missions to Mars (Grades 5-8 and 9-12)

All you need to know about Mars with mission updates. Be sure to check out M2K4 under Exploration rovers.
http://mars.jpl.nasa.gov/

Mars History of Probes (Grade 6-12)

http://nssdc.gsfc.nasa.gov/planetary/chronology_mars.html

USGS Planetary Maps (Grades 6-12)

See topographic and geology maps of Mars. Zoom in for a closer look and be sure to get the longitude and latitude coordinates as well.
http://planetarynames.wr.usgs.gov/mars/marsTOC.html

Background Information

Earth/Mars Comparison

	Mars	Earth
Average Distance from Sun	142 million miles	93 million miles
Average Speed in Orbiting Sun	14.5 miles per second	18.5 miles per second
Diameter	4,220 miles	7,926 miles
Tilt of Axis	25 degrees	23.5 degrees
Length of Year	687 Earth Days	365.25 Days
Length of Day	24 hours 37 minutes	23 hours 56 minutes
Gravity	.375 that of Earth	2.66 times that of Mars
Temperature	Average -81 degrees F	Average 57 degrees F
Atmosphere	mostly carbon dioxide some water vapor	nitrogen, oxygen, argon, others
# of Moons	2	1

Major types of volcanoes on Earth

Three basic types of volcanoes are recognized by geologists:

Shield Volcanoes

Shield volcanoes are large volcanic forms with broad summit areas and low-sloping sides (shield shape) because the extruded products are mainly low viscosity basaltic lava flows. A good example of a shield volcano is the Island of Hawaii (the "Big Island"). The Big Island is formed of five coalesced volcanoes of successively younger ages, the older ones apparently extinct.

Mauna Loa, one of the main volcanoes, has a higher elevation than any mountain on Earth -- 9090 meters (30,000 feet) from the floor of the ocean to its highest peak. Shield volcanoes have summit calderas formed by piston-like subsidence. Subsidence occurs when large volumes of lava are emptied from underground conduits; withdrawal of support leads to collapse. Many smaller pit craters also occur along fissure zones on the flanks of the volcanoes. These form by collapse due to withdrawal of magma along conduits.

Cinder Cones

Cinder cones are mounds of basaltic scoria that forms by streaming gases that carry lava blobs and ribbons into the atmosphere to form lava fountains. The lava blobs commonly solidify during flight through the air before landing on the ground. If gas pressure drops, the final stage of building a cinder cone may be a lava flow that breaks through the base of the cone. If there is abundant water in the environment, magma interacts with water to build a maar volcano rather than a cinder cone. The longer the eruption the higher the cone. Some are no larger than a few meters and others rise to as high as 610 meters or more, such as Paricutin volcano, Mexico that was in nearly continuous eruption from 1943 to 1952. Accompanying the pyroclastic activity were lava flows that emerged from its base to destroy the village of Paricutin. Cinder cones can occur alone but commonly occur in groups or fields.

Composite Volcanoes

Composite volcanoes are constructed from multiple eruptions, sometimes recurring over hundreds of thousands of years, sometimes over a few hundred. Andesite magma, the most common but not the only magma type forming composite cones, produces lava more brittle than basaltic lava because of its higher viscosity. Although andesitic composite cones are constructed dominantly of fragmental debris, some of the magma intrudes the cones as dike or sills. In this way, multiple intrusive events build a structural framework that knits together the voluminous accumulation of volcanic rubble, which can stand higher than cones composed solely of fragmental material. Composite cones can grow to such heights that their slopes become unstable and susceptible to collapse from the pull of gravity. Famous examples of composite cones are Mayon Volcano Philippines, Mount Fuji in Japan, and Mount Rainier, Washington, U.S.A. Some composite volcanoes attain two to three thousand meters in height above their bases. Most composite volcanoes occur in chains and are separated by several tens of kilometers. There are numerous composite volcano chains on earth, notably around the Pacific rim, known as the "Rim of Fire".

Contributors and Developers

Chris Chilelli	**Johnson Space Center**
Norm Chaffee	**Johnson Space Center**
Stephen Devine	**Johnson Space Center**
Rene Flores	**Johnson Space Center**
Sherri Jurls	**Johnson Space Center**

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www.teachnology.com